PROGRAMME PROJECT REPORT

M.Sc MATHEMATICS

(Distance Education Programme)

DIRECTORATE OF DISTANCE EDUCATION

ALAGAPPA UNIVERSITY

(A State University Accredite d with A+ Grade by NAAC (CGPA:3.64) in the Third Cycle)

KARAIKUDI- 630 003

M.Sc MATHEMATICS

Choice Based Credit System (CBCS)

(With effect from June 2018 – 2019 onwards)

a. Programme's Mission & Objectives:

To afford a High Quality Post Graduate Degree (M.Sc) Mathematics through Distance Learning mode to the students in order to nurture them in the emerging society among the young minds.

Objectives of the Course

This programme aims to develop an advanced training in mathematics with an emphasis on coursework. It offers opportunities to those who have an Honors degree or a Master degree in Mathematics to build and enhance their professional skills and qualifications in advanced mathematics in general and/or in some specialized areas of applied mathematics. The main objective of this course falls on the following aspects:

- To provide graduates with a comprehensive advanced knowledge of important areas of Mathematics
- To produce graduates of high level of analytic and technical skills required for the program
- To furnish them with the necessary background for further study in Mathematics and enhance their research capabilities
- To enable them to function effectively as teachers by giving seminar sessions in the related subjects

b. Relevance of the Programme with Alagappa University's Mission and Goals:

In order to align with the mission and goals of Alagappa University the M.Sc Mathematics is planned to deliver in Distance Learning mode which may reach the maximum number of student aspirants who are unable to thrive to spend non-elastic timings of formal conventional class room education. Such an undergraduate education in Mathematics subject with appropriate practical experiences will enrich the human resources for the uplift of the nation to Educational, Social, Technological, Environmental and Economic Magnificence (ESTEEM).

In accordance with the mission of Alagappa University as a research-intensive institution, the teaching programme of the master's programme in psychology is based on state of the art of scientific research and maintains a strong emphasis on the acquisition of academic and research skills.

c. Nature of Prospective Target Group of Learners:

The curriculum has been designed for the learners including a class having of low level of disposable income, rural dwellers, women, unskilled men, minorities etc. to apply mathematical knowledge and problem-solving techniques to investigate a problem, generate and/or analyse information, find relationships and patterns, describe these mathematically as general rules, and justify or prove them through Distance Learning mode. Especially this curriculum will helpful to the learners, professionals who are in teaching, social workers and the people who are working in various fields.

d. Appropriateness of programme to be conducted in Distance learning mode to acquire specific skills and competence:

M.Sc Mathematics programme through Distance Learning mode is developed in order to give subject-specific skills including to:

- recognize that mathematics permeates the world around us
- appreciate the usefulness, power and beauty of mathematics
- enjoy mathematics and develop patience and persistence when solving problems
- understand and be able to use the language, symbols and notation of mathematics
- develop mathematical curiosity and use inductive and deductive reasoning when solving problems
- become confident in using mathematics to analyse and solve problems both in school and in real-life situations
- develop the knowledge, skills and attitudes necessary to pursue further studies in mathematics
- develop abstract, logical and critical thinking and the ability to reflect critically upon their work and the work of others
- develop a critical appreciation of the use of information and communication technology in mathematics
- appreciate the international dimension of mathematics and its multicultural and historical perspectives.

The programme is developed to give the students to encourage to share their thinking with teachers and peers and to examine different problem-solving strategies. Critical reflection in mathematics helps students gain insight into their strengths and weaknesses as learners and to appreciate the value of errors as powerful motivators to enhance learning and understanding.

At the end of the Programme students should be able to:

- Explain whether their results make sense in the context of the problem
- Explain the importance of their findings
- Justify the degree of accuracy of their results where appropriate
- Suggest improvements to the method when necessary.

e. Instructional Design:

e. 1. Curriculum Design:

Sl. No.	Course Code	Title of the Course	CIA Max.	ESE Max.	TOT Max.	C Max.
FIRST YEAR						
I Semester						
1.	**31111**	Algebra – I	25	75	100	4
2.	**31112**	Analysis – I	25	75	100	4
3.	**31113**	Ordinary Differential Equations	25	75	100	4
4.	**31114**	Topology – I	25	75	100	4
		Total	**100**	**300**	**400**	**16**
II Semester						
5.	**31121**	Algebra–II	25	75	100	4
6.	**31122**	Analysis–II	25	75	100	4
7.	**31123**	Topology – II	25	75	100	4
8.	**31124**	Partial Differential Equations	25	75	100	4
		Total	**100**	**300**	**400**	**16**
SECOND YEAR						
III Semester						
9.	**31131**	Differential Geometry	25	75	100	4
10.	**31132**	Optimization Techniques	25	75	100	4

11.	**31133**	Analytic Number Theory	25	75	100	4
12.	**31134**	Stochastic Processes	25	75	100	4
		Total	**100**	**300**	**400**	**16**
IV Semester						
13.	**31141**	Graph Theory	25	75	100	4
14.	**31142**	Functional Analysis	25	75	100	4
15.	**31143**	Numerical Analysis	25	75	100	4
16	**31144**	Probability And Statistics	25	75	100	4
		Total	**100**	**300**	**400**	**16**

Course Code Legend:

3	**1**	**1**	**X**	**Y**	**Z**

3**11-** M.Sc., Mathematics
X -Semester No
Y & Z- Course number in the semester

CIA: Continuous Internal Assessment, ESE: End Semester Examination, TOT: Total, C: Credit Points, Max.: Maximum

No. of Credits per Course (Theory) -4
Total No. of Credits per Semester- 16
Total No. of Credits per Programme - 16 X 4 = 64

e. 2. Detailed Syllabi:

SEMESTER-I

Course Code	Title of the Course
31111	**ALGEBRA– I**

Course Objectives:

The objective of the course is to

- introduce and study the basic properties of groups, normal sub groups and quotient groups.
- derive the notion of homomorphism, automorphism on groups and permutation groups.
- introduce the above mentioned concepts in Sylow's Theorems, direct products and finite abelian groups.
- study the structure of rings, some special classes of rings, ideals and quotient rings.
- define Euclidean rings, polynomial rings, polynomial rings over commutative rings and study their important properties and theorems.

Course Description:

BLOCK I: GROUPS AND NORMAL SUB GROUPS

UNIT – I

Set Theory - Mappings - The Integers -problems

UNIT -II

Group Theory: Definition of a group – Some examples of Groups – Some preliminary Lemmas – Subgroups

UNIT -III

A counting principle – Normal subgroups and Quotient groups

UNIT -IV

Homomorphisms – Automorphisms - Cayley's Theorem - Permutation Groups

BLOCK II: SYLOW'S THEOREM AND RING THEORY

UNIT -V

Another counting Principle – Application – Related problems

UNIT -VI

Sylow's Theorem - Direct products - Problems

UNIT -VII

Finite Abelian Groups – Supplementary problems

UNIT -VIII

Ring Theory: Definition and examples of rings – Some special classes of Rings

BLOCK III: RING HOMOMORPHISM, IDEAS AND FIELDS

UNIT -IX

Ring Homomorphisms - Ideals and Quotient Rings - Problems

UNIT -X

More ideals and Quotient Rings – Related Problems

UNIT -XI

The field of quotients of an Integral Domain - Euclidean Rings – Related Problems

BLOCK IV: EUCLIDEAN RING AND POLYNOMIAL RINGS

UNIT -XII

A Particular Euclidean Ring - Polynomial Rings

UNIT -XIII

Polynomials over the Rational Field – Related Problems

UNIT -XIV

Polynomial Rings over Commutative Rings – Supplementary Problems

REFERENCES:

1. I.N.Herstein, Topics in Algebra (2nd Edition) Wiley Eastern Limited, New Delhi, 1975.
2. M.Artin, Algebra, Prentice Hall of India, 1991.
3. John B.Fraleigh, A First Course in Abstract Algebra, Addison Wesley, Mass, 1982.
4. D.S.Malik, J.N.Mordeson and M.K.Sen, Fundamentals of Abstract Algebra, McGraw Hill (International Edition), New York, 1997.

Learning Outcomes:

After the successful completion of this course, students will be able to:

- understand the concepts of groups, normal subgroups and quotient groups.
- explain the concepts of homomorphism, automorphism on groups and permutation groups.
- analyze basic concepts about rings, ideals and quotient rings.
- demonstrate the examples of Euclidean rings, polynomial rings, polynomial rings over Commutative rings.

Course Code	Title of the Course
31112	**ANALYSIS – I**

Course Objectives:

The objective of the course is to:

- prove various statements by induction and emphasize the proofs' development.
- define the limit of a function at a value, a limit of a sequence, and the Cauchy criterion.
- prove various theorems about limits of sequences and functions and emphasize the proofs' development.
- prove various theorems about the series and emphasize the proofs' development.
- prove various theorems about the derivatives of functions and emphasize the proofs' development

Course Description:

BLOCK I: COMPLEX NUMBER, COMPACT AND CONNECTED SETS

UNIT -I

The Real and Complex Number Systems: Introduction- Ordered Sets –Fields- The Real Fields

UNIT -II

The Extended Real Number System- Complex field- Euclidean spaces -Problems

UNIT- III

Basic Topology: Finite- Countable and Uncountable Sets- Metric Spaces

UNIT- IV

Compact sets – Perfect sets – Connected sets- Problems

BLOCK II: SEQUENCES, SERIES AND CONTINUITY OF FUNCTION

UNIT -V

Numerical sequences and series; Convergent sequences- Subsequences- Cauchy sequences- Upper and Lower limits

UNIT -VI

Special sequences- Series- Series of non–negative terms- The number e – The root and ratio tests.

UNIT -VII

Power series – Summation by parts- Absolute convergence – Addition and Multiplication of series – Rearrangements

UNIT -VIII

Continuity: Limits of Functions – Continuous Functions- Continuity and Compactness- Continuity and Connectedness

BLOCK III: BOLZANO-WEIERSTRASS AND CANTOR INTERACTION THEOREM

UNIT -IX

Discontinuities – Monotonic Functions - Infinite Limits and Limits at Infinity

UNIT -X

Open balls- Closed balls in R^n – Closed Sets and Adherent Points – The Bolzano-Weierstrass Theorem

UNIT -XI

The Cantor intersection theorem – The Heine - Borel covering theorem – Compactness in R^n

BLOCK VI: DERIVATIVES AND PARTIAL DERIVATIVES

UNIT -XII

Derivatives – The Chain Rule- Functions with Nonzero Derivative- Zero Derivatives and Local Extrema- Rolle's theorem- The Mean-value Theorem for Derivatives

UNIT -XIII

The Mean-value Theorem for Derivatives - Intermediate value theorem for Derivatives- Taylor's Formula with Remainder

UNIT -XIV

Partial derivatives- Directional derivative- The Total derivative- The Inverse function theorem- The Implicit function theorem – Problems

REFERENCES:

1. Tom M Appostol, *Mathematical Analysis*, Second edition(1974)Addision Wesley.
2. Walter Rudin, Principles of Mathematical Analysis, III Edition, McGraw-Hill Book Company, 1976.
3. H.L.Royden, Real Analysis, Macmillan Publ.co., Inc. 4th edition, New York, 1993.
4. V.Ganapathy Iyer, Mathematical Analysis, Tata McGraw Hill, New Delhi, 1970.
5. Robert G.Bartle, Donald R.Sherbert, Introduction to *Real Analysis*, Third edition, (2000)John Wiley & Sons.

Learning Outcomes:

After the successful completion of this course, students will be able to:

- define and recognize the basic properties of the field of real numbers. Improve and outline the logical thinking.
- define and recognize the series of real numbers and convergence shown the ability of working independently and with groups.
- comprehend rigorous arguments developing the theory underpinning real analysis.
- demonstrate an understanding of limits and how they are used in sequences, series, differentiation and integration.
- appreciate how abstract ideas and rigorous methods in mathematical analysis can be applied to important practical problems.

Course Code	Title of the Course
31113	ORDINARY DIFFERENTIAL EQUATIONS

Course Objectives:

The objective of the course is to:

- formulate ordinary differential equations (ODEs) and seek understanding of their solutions, either obtained exactly or approximately by analytic or numerical methods.
- understand the concept of a solution to an initial value problem, and the guarantee of its existence and uniqueness under specific conditions.
- recognize basic types of differential equations which are solvable, and will understand the features of linear equations in particular.
- use different approaches to investigate equations which are not easily solvable. In particular, the student will be familiar with phase plane analysis.

Course Description:

BLOCK I: LINEAR DIFFERENTIAL EQUATIONS WITH CONSTANT COEFFICIENTS AND INITIAL VALUE PROBLEMS

UNIT-I

Linear Equations with Constant Coefficients: Introduction - The Second Order Homogeneous Equation

UNIT -II

Initial Value Problems for Second Order Equations –Related Problems

UNIT- III

Linear Dependence and Independence - Problems

UNIT-IV

A formula for the Wronskian – Non-Homogenous Equation of Order Two related Problems

BLOCK II: HOMOGENEOUS AND NON HOMOGENEOUS EQUATIONS OF ORDER n

UNIT- V

Homogeneous equation of order n - initial value problems for n^{th} order equations – Equations with Real Constants

UNIT -VI

Non-Homogeneous Equations of order n – Related Problems

UNIT -VII

Linear Equations with variable Coefficients: Reduction of the order of a Homogeneous Equation – Non-homogeneous Equation

BLOCK III: LINEAR EQUATIONS WITH REGULAR SINGULAR POINTS

UNIT -VIII

Homogeneous Equations with Analytic Coefficients – Legendre Equation.

UNIT -IX

Linear Equations with Regular Singular Points – Euler Equations - Second order Equations with Regular Singular Points – An Example

UNIT -X

Second order Equations with Regular Singular Points – General Case – Exceptional Cases

UNIT-XI

Bessel Equation – Bessel Equation (continued) – Regular Points at Infinity.

BLOCK IV: EXACT EQUATIONS AND METHOD OF SUCCESSIVE APPROXIMATATION

UNIT-XII

Existence and Uniqueness of Solutions to First order Equations : Equations with variables separated – Exact equations

UNIT -XIII

Method of successive approximations – Lipchitz condition – Convergence of the successive approximations.

UNIT -XIV

Nonlocal existence of solutions - Approximations to solutions and uniqueness of solutions- Existence and uniqueness of solutions to systems and n^{th} order equations - Existence and uniqueness of solutions to system.

REFERENCES:

1. Earl A.Coddington, An Introduction to Ordinary Differential Equations – Prentice Hall of India, 1987.
2. D.Somasundaram, Ordinary Differential Equations, Narosa Publishing House, Chennai, 2002.
3. M.D.Raisinghania, Advanced Differential Equations, S.Chand and Company Ltd, New Delhi, 2001.

Learning Outcomes:

After successful completion of this course, student will be able to:

- apply the fundamental concepts of ordinary differential equations and partial differential equations and the basic numerical methods for their resolution.
- solve the problems choosing the most suitable method.
- understand the difficulty of solving problems analytically and the need to use numerical approximations for their resolution.
- use computational tools to solve problems and applications of ordinary differential equations and partial differential equations.
- formulate and solve differential equation problems in the field of industrial organization engineering.
- use an adequate scientific language to formulate the basic concepts of the course.

Course Code	Title of the Course
31114	TOPOLOGY – I

Course Objectives:

The objectives of the course is to:

- explain how to distinguish spaces by means of simple topological invariants (compactness, connectedness and the fundamental group).
- explain how to construct spaces by gluing and to prove that in certain cases that the result is homeomorphic to a standard space.
- construct simple examples of spaces with given properties.
- Define Urysohn's lemma and Urysohn's metrization theorem and find the applications of them.

Course Description:

BLOCK I: FUNDAMENTALS, FINITE AND INFINITE SETS

UNIT-I

Set Theory and Logic : Fundamental Concepts- Functions- Relations - The Integers and the Real Numbers

UNIT-II

The Integers and the Real Numbers - Cartesian Products- Finite Sets - Countable and Uncountable sets

UNIT-III

Infinite sets and the Axiom of choice- ordered sets- The Maximum Principle

UNIT-IV

Topological Spaces – Basis of a topology – Problems

BLOCK II: TOPOLOGICAL SPACES

UNIT-V

The order topology – The product topology on X x Y - Problems

UNIT-VI

The subspace topology – Closed sets and limit points – Hausdorff spaces

UNIT-VII

Continuous Functions – Continuity of a Function- Homomorphisms

The product topology

UNIT-VIII

Constructing continuous Functions -The metric topology - The quotient topology.

BLOCK III: CONNECTED AND COMPACT SPACES

UNIT-IX

Connected spaces – Connected sets in the real line –component and path components

UNIT -X

Local connectedness - Compact spaces - Problems

UNIT -XI

Compact sets in the real line - Limit point compactness - Local Compactness

BLOCK IV: COUNTABILITY AXIOMS AND NORMAL SPACES

UNIT -XII

The Countability axioms - The separation axioms - Problems

UNIT -XIII

Normal spaces - The Urysohn's lemma

UNIT -XIV

The Uryshon's metrization theorem – Related Problems

REFERENCES:

1. James R.Munkres, Topology a first course, Prentice Hall of India Pvt. Ltd.,New Delhi (1987)
2. James Dugundji, Topology, Prentice Hall of India, New Delhi, 1975.
3. George F.Simmons, Introduction to Topology and Modern Analysis, McGraw Hill Book Co., 1963.

Learning Outcomes:

Upon successful completion of the course, students will be able to:

- define and illustrate the concept of topological spaces and continuous functions,
- prove a selection of theorems concerning topological spaces, continuous functions, product topologies, and quotient topologies.
- define and illustrate the concept of product topology
- define and illustrate the concepts of the separation axioms.
- define connectedness and compactness, and prove a selection of related theorems, and describe different examples distinguishing general, geometric, and algebraic topology.

SEMESTER-II

Course Code	Title of the Course
31121	ALGEBRA–II

Course objectives:

The main objective of the course is to:

- study the basic concepts of linear independence and bases, dual spaces and inner product spaces.
- determine roots of polynomials, extension fields and more about roots.
- introduce the concept of Galois Theory and derive the condition for the solvability by means of radicals.
- analyze the characteristic roots of linear transformation and study about Nilpotent transformations.
- define Hermitian, unitary and normal transformations.

Course Description:

BLOCK I: VECTOR SPACES AND FIELDS

UNIT-I

Vector Space: Elementary basic concepts -Problems

UNIT-II

Vector Space: Linear Independence and Bases

UNIT-III

Dual spaces – Inner product spaces – Problems

UNIT-IV

Field: Extension Fields - Roots of Polynomials – Related Problems

BLOCK II: GALOIS THEORY AND LINEAR TRANSFORMATIONS

UNIT-V

Construction with Straight edge and Compass - More about roots.

Unit-VI

The Elements of Galois theory – Related Problems

UNIT-VII

Linear Transformations: The Algebra of linear transformations - Problems

UNIT-VIII

Linear Transformations: Characteristic roots - Matrices –Problems

BLOCK III: CANONICAL FORMS AND DETERMINANTS

UNIT-IX

Linear Transformations: Canonical Forms - Triangular Form

UNIT-X

Linear Transformations: Canonical Forms - Rational Canonical Form

UNIT-XI

Trace and Transpose – Determinants

BLOCK IV: HERMITIAN AND NORMAL TRANSFORMATIONS AND FINITE FIELDS

UNIT-XII

Hermitian Transformations --Related Problems

UNIT-XIII

Unitary and Normal Transformations

UNIT-XIV

Finite Fields- Related Problems

REFERENCES:

1. I.N.Herstein, Topics in Algebra (2nd edition) John Wiley and Sons, New York.
2. P.B.Bhattacharya, S.K.Jain and S.R.Nagpaul, Basic Abstract Algebra (2nd edition) Cambridge University Press, 1997 (Indian Edition)
3. S.Lang, Algebra 3rd edition, Addison-Wesley, Mass, 1993.
4. N.Jacobson, Basic Algebra, Vol. I & II W.H.Freeman, also Published by Hindustan Publishing Company, New Delhi, 1980.

Learning Outcomes:

After successful completion of this course, students will be able to:

- analyze and demonstrate examples of linear independence and bases, dual Spaces and inner product spaces.
- assess properties implied by roots of polynomials and more about roots.
- classify and determine the trace and transpose of the matrices.
- define, illustrate and apply the concepts of unitary Hermitian and normal transformation.

Course Code	Title of the Course
31122	**ANALYSIS–II**

Course Objectives:

This course is aimed to provide

- an introduction to the theories for Riemann-Stieltjes Integral. It begins with the exploration of the Existence of the integral.
- the concepts of vector valued functions and Rectifiable curves are introduced.
- the notion of sequences and series is presented and to help the students to visualize the uniform convergence.
- understanding of the fundamental concepts of some special functions.
- the skill of Lebesque measure to evaluate them via examples.

Course Description:

BLOCK I: RIEMANN-STIELTJES INTEGRAL AND SEQUENCES AND SERIES OF FUNCTIONS

UNIT-I

Riemann-Stieltjes Integral: Definition and Existence of the Integral

UNIT-II

Properties of the Integral- Integration and Differentiation - Problems

UNIT-III

Integration of vector-valued functions - Rectifiable curves.

UNIT-IV

Sequences and Series of functions: Discussion of main problem- Uniform convergence

BLOCK II: UNIFORM CONVERGENCE AND SOME SPECIAL FUNCTIONS

UNIT-V

Uniform convergence and Continuity- Uniform convergence and Integration - Uniform convergence and Differentiation

UNIT-VI

Equicontinuous families of functions - The Stone Weierstrass theorem.

UNIT-VII

Some special functions: Power series- the Exponential- Logarithmic and Trigonometric functions

UNIT-VIII

The Algebraic completeness of the Complex field – Fourier Series – The Gamma function.

BLOCK III: LEBESQUE MEASURE MEASURABLE AND NON MEASURABLE SETS

UNIT-IX

Lebesque measure - Outer measure- Measurable sets and Lebesgue measure

UNIT-X

Measurable functions- Egoroff's theorem- Lusin's theorem

UNIT-XI

Non-measurable sets – Lebesgue measurable functions – Little wood's three principles.

BLOCK IV: LEBESQUE INTEGRAL AND CONVERGENCE THEOREMS ON MEASURABLE FUNCTION

UNIT-XII

Lebesgue Integral: Riemann integral – Lebesgue Integral of a bounded function over a set of finite measure

UNIT-XIII

Lebesgue Integral of nonnegative measurable function – General Lebesgue integral

UNIT-XIV

Convergence theorems on measurable functio ns.

REFERENCES:

1. Walter Rudin, Principles of Mathematics Analysis (3rd edition), McGraw Hill 1976.
2. H.L. Royden, Real Analysis (3rd edition) Macmillan Publishing Company, New York, 1988.
3. G.De Barra, Measure Theory and Integration, Wiley Easten Ltd., New Delhi, 1987.
4. Malik S.C. and Savita Arora, Mathematical Analysis, Wiley Eastern Limited, New Delhi, 1991.
5. Robert G.Bartle, Donald R.Sherbert, Introduction to *Real Analysis*, Third edition, (2000)John Wiley & Sons.

Learning Outcomes:

Upon successful completion of this course, students will be able to:

- extend the concepts of Riemann integral
- differentiate and Integrate Complex functions.
- carry out Stone Weierstrass theorem.
- compute sequence and series of functions.
- apply techniques of measurable functions in varies fields.

Course Code	Title of the Course
31123	TOPOLOGY – II

Course Objectives:

The objectives of the course is to:

- explain how to distinguish regular spaces by means of simple topological invariants.
- explain how to construct Smirnov Metrization Theorem, Nagata Smirnov Metrization Theorem and to prove that in certain cases.
- Explain the concepts of complete metric spaces and open topology with suitable examples.
- construct simple examples of Baire spaces with given properties

Course Description:

BLOCK I: TIETZE EXTENSION THEOREM AND COMPLETELY REGULAR SPACES

UNIT-I

The Tietze Extension Theorem - Applications

UNIT-II

The Tychonoff Theorem - Problems

UNIT-III

Completely Regular Spaces - The Stone-Cech Compactification

UNIT-IV

Metrization theorems and Paracompactness: Local Finiteness - The Nagata Smirnov Metrization Theorem (Sufficiency) – The Nagata Smirnov Theorem (necessity).

BLOCK II: COMPLETE AND COMPACT METRIC SPACES

UNIT- V

Paracompactness – The Smirnov Metrization Theorem - Problems

UNIT-VI

Complete Metric Spaces and Function Spaces: Complete metric spaces

UNIT-VII

A Space – Filling Curve - Compactness in Metric spaces

UNIT-VIII

Point wise and compact convergence – Related Problems

BLOCK III: COMPACT-OPEN TOPOLOGY AND BAIRE SPACES

UNIT-IX

The Compact – Open Topology – Related problems

UNIT-X

Ascoli’s theorem – Related problems

UNIT-XI

Baire Spaces – Applications

BLOCK IV: NOWHERE DIFFERENTIABLE FUNCTIONS AND DIMENSION THEORY

UNIT-XII

Nowhere differentiable Functions – Theorems.

UNIT-XIII

Nowhere differentiable Functions - Related Problems

UNIT-XIV

Introduction to Dimension Theory

REFERENCES:

1. James R Munkres, Topology, A First Course, Prentice Hall of India, New Delhi (1984).
2. JL.Kelley, General Topology, Van Nostrnad, Reinhold Co., New York.
3. K.D.Joshi, Introduction to General Topology, Wiley Eastern Ltd., 1983.

Learning Outcomes:

Upon successful completion of the course, students will be able to:

- define and illustrate the concept of Regular spaces and Baire spaces.
- prove a selection of theorems concerning Regular spaces and Baire spaces,
- define and illustrate the concept of open topology.
- define and illustrate the concepts of the Metric spaces and Function spaces.
- define compactness and nowhere differentiable, and prove a selection of related theorems, and describe different examples

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Course Code	Title of the Course
31124	PARTIAL DIFFERENTIAL EQUATIONS

Course Objectives:

The objectives of this course is to:

- introduce the notion of partial differential equations.
- introduce students to how to solve linear partial differential with different methods.
- introduce some physical problems in Engineering and Biological models that results in partial differential equations.

Course Description:

BLOCK I: ODE IN MORE THAN TWO VARIABLES AND PAFFIAN DIFFERENTIAL EQUATION

UNIT-I

Ordinary differential equations in more than two variables : Surfaces and curves in three dimensions

UNIT-II

Simultaneous differential equations of the first order and the first degree in three variables

UNIT-III

Methods of solution of dx/P=dy/Q=dz/R - Orthogonal trajectories of a system of curves on a surface

UNIT-IV

Pfaffian differential forms and equations – Solution of Pfaffian differential equations - The three variables.

BLOCK II: LINEAR AND NON LINEAR PDE

UNIT-V

Partial differential equations of the first order : Partial differential equations – origins of first order partial differential equations

UNIT-VI

Cauchy's problem for first order equations – Linear equations of the first order-Integral surfaces passing through a given curve

UNIT-VII

Surfaces orthogonal to a given system of surfaces - Nonlinear partial differential equations of the first order-Cauchy's method of characteristics.

UNIT-VIII

Compatible systems of first order equations – Charpits method - special types of first order equations – solutions satisfying given conditions - Jacobi's method

BLOCK III: PDE WITH CONSTANT COEFFICIENTS AND INTEGRAL TRANSFORMS

UNIT-IX

Partial differential equations of the second order : Origin of second order equations

UNIT-X

Linear partial differential equations with constant coefficients. Equations with variable coefficients – separation of variables

UNIT-XI

Method of integral transforms (exercise problems are excluded)

BLOCK IV: LAPLACE, WAVE AND DIFFUSION EQUATIONS

UNIT-XII

Laplace's equation : Elementary solutions of Laplace's equation – boundary value problems

UNIT-XIII

The Wave equation – Elementary solutions of the one dimensional wave equation

UNIT-XIV

The Diffusion equation : Elementary solutions of the diffusion equation – separation of variables.

REFERENCES:

1. I.N.Sneddon,Elements of Partial Differential Equations,McGraw Hill Book Company, 1986.
2. M.D.Raisinghania, Advanced Differential Equations, S.Chand&Company Ltd.,New Delhi, 2001.
3. K.Sankara Rao, Introduction to Partial Differential Equations, Second Edition, Prentice – Hall of India, New Delhi, 2006.
4. J.N.Sharma and K.Singh, Partial Differential Equations for Engineers and Scientists, Narosa Publishing House, Chennai, 2001.

Learning Outcomes:

Upon successful completion of this course, students will be able to:

- classify partial differential equations and transform into canonical form.
- solve linear partial differential equations of both first and second order.

SEMESTER-III

Course Code	Title of the Course
31131	DIFFERENTIAL GEOMETRY

Course Objectives:

The general objective of the course is to:

- introduce the concepts of a curve, arc-length, curvature, plane curves, space curves, Frenet –Serret equations.
- make the knowledge about surfaces, smooth surfaces, tangents, normals, quadratic surfaces.
- introduce the concepts of lengths of curves on surfaces, isometries of surfaces, conformal mappings of surfaces.
- understand the celebrated Gauss-Bonnet theorem, the second fundamental form, the curvature of curves on a surface, the normal and principal curvatures, geometric interpretation of principal curvatures.
- give awareness to learners about The Gaussian and mean curvatures, The surfaces of constant mean curvature, Gaussian curvature of compact surfaces.
- introduce the basic properties of Geodesics, Geodesic equations, Geodesics on surfaces of revolution.

Course Description:

BLOCK I: SPACE CURVES AND SURFACES

UNIT-I

Introductory remark about space curves – definitions – arc length – Tangent, Normal and binormal

UNIT-II

Curvature and Torsion of a curve given as the intersection of two surfaces.

UNIT-III

Contact between curve and surfaces – Tangent surface, Involutes and evolutes

UNIT-IV

Intrinsic equations – Fundamental Existence Theorem for space curves

BLOCK II: HELICES, HELICOIDS AND FAMILIES OF CURVES

UNIT-V

Helices-Types of helices-Problems.

UNIT-VI

Definition of a surface – curves on a surfaces – Surfaces of revolution

UNIT-VII

Helicoids – Metric – Direction coefficients

UNIT-VIII

Families of curves – Isometric Correspondence – Intrinsic properties.

BLOCK III: GEODESIC PARALLELS AND GEODESIC CURVATURES

UNIT-IX

Geodesics – Canonical Geodesic equations – Normal property of Geodesics– Existence theorem**.**

UNIT-X

Geodesic Parallels – Problems in Geodesic parallels.

UNIT-XI

Geodesic Curvature – Gauss – Bonnet Theorem Gaussian curvature.

BLOCK IV: LINER OF CURVATURE AND DEVELOPABLES

UNIT-XII

The Second Fundamental from – Principal curvature–Lines of Curvature

UNIT-XIII

Developables - Developables associated with space curves.

UNIT-XIV

Developables associated with curves on surfaces.

REFERENCES:

1. T.G. Willmore – An Introduction to Differential Geometry, Oxford University press (1983).

Learning Outcomes:

At the end of the module, students should be able to:

- understand the curvature and torsion of a space curve, how to compute them, and how they suffice to determine the shape of the curve.
- understand the definition of a smooth surface, and the means by which many examples may be constructed.
- understand the various different types of curvature associated to a surface, and how to compute them.
- understand the first and second fundamental forms of a surface, how to compute them, and how they suffice to determine the local shape of the surface.
- understand about Gaussian curvature, geodesics and its applications, how to compute them
- appreciate the distinction between intrinsic and extrinsic aspects of surface geometry.

Course Code	Title of the Course
31132	**OPTIMIZATION TECHNIQUES**

Course Objectives:

The general objective of the course is to:

- introduce the fundamental concepts of optimization techniques.
- make the learners aware of the importance of optimizations in real scenarios.
- provide the concepts of various classical and modern methods of for constrained and unconstrained problems in both single and multivariable.

Course Description:

BLOCK I: NETWORK MODELS

UNIT-I

Network Models: Minimal spanning tree algorithm - Problems

UNIT-II

Shortest route algorithms -Problems

UNIT-III

Maximal flow Model-Problems

UNIT-IV

Critical path calculations - Tree and total floats – Problems

BLOCK II: ADVANED LINEAR PROGRAMMING AND GAME THEORY

UNIT-V

Advanced Linear Programming - Simplex method using the restricted basis –

UNIT-VI

Bounded variables Algorithm - Revised Simplex method.

UNIT-VII

Game Theory - Optimal solution of Two Person Zero Sum Games

UNIT-VIII

Solution of mixed strategy Games – Related problems.

BLOCK III: SOLUTION OF GAMES USING LPP AND OPTIMIZATION THEORY

UNIT-IX

Game theory Linear programming solution of games.

UNIT-X

Classical Optimization Theory -Jacobian Method -Problems

UNIT-XI

Lagrangian Method - The Newton Raphson –Problems

BLOCK IV: KKT METHODS, SEPARABLE AND QUADRATIC PROGRAMMING

UNIT-XII

Karush- Kuhn- Tucker conditions.-Problems

UNIT-XIII

Unconstrained algorithms - Non Linear Programming Algorithms.

UNIT-XIV

Separable programming – Quadratic Programming.

REFERENCES:

1. Operations Research, H.A. Taha, 8th edition, Prentice Hall, New Delhi, 2008.

Learning Outcomes:

Upon successful completion of this course, students will be able to:

- understand the theory of optimization methods and algorithms developed for solving various types of optimization problems and to formulate optimization problems.
- understand and apply the concept of optimality criteria for various types of optimization problems.
- solve various constrained and unconstrained problems in single variable as well as multivariable.
- apply the methods of optimization in real life situation.
- develop and promote research interest in applying optimization techniques in problems.

Course Code	Title of the Course
31133	**ANALYTIC NUMBER THEORY**

Course Objectives:

The main objective of the course is to:

- gain an understanding and appreciation of analytic number theory and some of its important applications.
- use the theory in specific examples.
- focus on the properties of prime numbers and to understand prime number theorem.
- understand the partitions of numbers and learn techniques to relate the subject with Combinatorics.

Course Description:

BLOCK I: FUNTAMENTAL, PRIME NUMBERS AND ARITHEMETIC FUNCTIONS

UNIT-I

The Fundamental Theorem of Arithmetic: Introduction – Divisibility – Greatest common divisor

UNIT-II

Prime Numbers – The series of reciprocals of the primes - The Euclidean Algorithm – The greatest common divisors of more than two numbers.

UNIT-III

Arithmetical Functions and Dirichlet Multiplication: Introduction; The Mobius function $\mu(n)$ – The Euler Totient Function $\phi(n)$ - A relation connecting ϕ and μ - A Product formula for $\phi(n)$.

UNIT-IV

The Dirichlet product of arithmetical functions: Dirichlet inverses and the mobius inversion formula - The Mangoldt function Λ (n)

BLOCK II: MULTIPLICATIVE FUNCTIONS AND FORMAL POWER SERIES

UNIT-V

Multiplicative functions – Multiplicative functions and Dirichlet multiplication - The inverse of a Completely multiplicative function - Liouvil e's function λ (n), The divisor functions σ_α (n)

UNIT-VI

Generalized Convolutions – Formal Power Series

UNIT-VII

The Bell series of an arithmetical function - Bell series and Dirichlet Multiplication – Derivatives of arithmetical functions - The Selberg Identity.

UNIT-VIII

Averages of Arithmetical Functions: Introduction, The big oh notation. Asymptotic equality of functions

BLOCK III: DIRICHLET PRODUCT AND CONGRUENCES

UNIT-IX

Euler's summation formula - Some elementary asymptotic formulas – The average order of d (n) – The average order of the divisor functions σ_α (n)

UNIT-X

The average order of φ (n) - An application to the distribution of lattice points, visible from the origin - The average order μ (n) and of Λ (n) - The partial sums of a Dirichlet product – Applications to μ(n) and Λ (n) Another identity for the partial sums of a Dirichlet product.

UNIT-XI

Congruences: Definition and Basic properties of congruences - Residue classes and complete residue systems - Linear congruences – Reduced residue systems and the Euler – Fermat theorem

BLOCK IV: POLYNOMIAL CONGRUENCES AND QUADRATIC RESIDUES

UNIT-XII

Polynomial congruences modulo *p* Lagrange's theorem – Applications of Lagrange's theorem - Simultaneous linear congruences. The Chinese remainder theorem – Application of the Chinese remainder theorem

UNIT-XIII

Polynomial congruences with prime power moduli - The principle of cross classification - A decomposition property of reduced residue systems.

UNIT-XIV

Quadratic residuces and the Quadratic Reciprocity Law: Lagrange's symbol and its properties– Evaluation of (-1/p) and (2/P) – Gauss's Lemma – The quadratic reciprocity law - Applications of the reciprocity law - The Jacobi symbol - Applications to Diophantine Equations.

REFERENCES:

1. Tom M. Apostal, Introduction to Analytic Number theory, Springer Verlag.
2. Niven and H.S.Zuckerman, An Introduction to the Theory of Numbers, 3rd Edition, Wiley Eastern Ltd., New Delhi, 1989.
3. D.M.Burton, Elementary Number Theory, Universal Book Stall, New Delhi, 2001.

Learning Outcomes:

At the end of the course, students will be able to:

- analyze and prove results presented in analytic number theory.
- prove results similar to the ones presented in the course and apply the basic techniques, results and concepts of the course to concrete examples and exercises.
- understand the interdisciplinary nature with other mathematical branches.
- understand theoretical physics and Combinatorics with the knowledge of partition theory.

Course Code	Title of the Course
31134	STOCHASTIC PROCESSES

Course Objectives:

The objective of this course is to:

- Provide the fundamentals and advanced concepts of probability theory and random process to support graduate coursework and research in electrical, electronic and computer engineering.
- The required mathematical foundations will be studied at a fairly rigorous level and the applications of the probability theory and random processes to engineering problems will be emphasized.

Course Description:

BLOCK I: MARKOV CHAINS AND MARKOV PROCESS

UNIT-I

Definition of Stochastic Processes – Markov chains: definition, order of a Markov chain – Higher transition probabilities.

UNIT-II

Classification of states and chains – denumerable number of states and reducible chains

UNIT-III

Markov process with discrete state space: Poisson process – and related distributions– properties of Poisson process, Generalizations of Poisson processes –

UNIT-IV

Birth and death processes – continuous time Markov chains.

BLOCK II: WEINER AND BRANCHING PROCESS

UNIT-V

Markov processes with continuous state space - Introduction, Brownian motion - Problems

UNIT-VI

Weiner process and differential equations for it, Kolmogrov equations – Problems

UNIT-VII

First passage time distribution for Weiner process – Ornstein – Uhlenbech process.

UNIT-VIII

Branching processes : Introduction – properties of generating functions of Branching Process

BLOCK III: PORBABILITY OF EXTINCTION AND STOCHASTIC PROCESS IN M/M/1-MODEL

UNIT-IX

Probability of extinction – Distribution of the total number of progency conditional limit laws due to kolmogrov and due to Yaglom,

UNIT-X

The classical Galton and Watson process – Be**l** man Hari's process

UNIT-XI

Stochastic processes in Queueing Systems -Concepts – Queueing model M/M/1 – transient behaviour of M/M/1 model

BLOCK IV: BIRTH AND DEATH PROCESS AND BULK SERVICE SYSTEM IN QUEUEING THEORY

UNIT-XII

Birth and death process in Queueing theory: M/M/1 model and related distributions – M/M/ ∞/ - M/M/S/S – loss system – M/M/S/M.

UNIT-XIII

Non birth and death Queueing process -Bulk queues – $M^{(x)}$ / M/1 model-Problems

UNIT-XIV

Bulk service system- poisson queue with general bulk service rule – M/M(a,b)/1 model – M/M/M(K,K)/1 model – M/M(1,b)/1 – M/M (a,∞)/ 1 model.

REFERENCES:

1. J.Medhi – Stochastic Processes – New age international Private limited – Second edition –1993.
2. Gregory F.Lawler – Introduction to Stochastic Process, Chapman and Hall / CRC

Learning Outcomes

After successful completion of this course, students will be able to

- possess the basic knowledge about stochastic processes in the time domain.
- acquire more detailed knowledge about Markov processes with a discrete state space, including Markov chains, Poisson processes & birth and death processes.
- know about queuing systems and Brownian motion, in addition to mastering the fundamental principles of simulation of stochastic processes and the construction of Markov chain Monte Carlo (MCMC) algorithms.
- formulate simple stochastic process models in the time domain and provide qualitative and quantitative analyses of such models.

SEMESTER-IV

Course Code	Title of the Course
31141	**GRAPH THEORY**

Course Objectives:

The objective of the course is to:

- introduce students with the fundamental concepts of graph theory, with a sense of some of its modern applications.
- use these methods in subsequent courses in the design and analysis of algorithms, computability theory, software engineering, and computer systems.
- cover a variety of different problems in Graph Theory.
- come across a number of theorems and proofs.
- prove theorems which will be stated formally using various techniques.
- learn various graphs algorithms which will also be taught along with its analysis.

Course Description:

UNIT-I

Graphs – Subgraphs – Graph Isomorphism – Incidence and adjacency matrices – Vertex degrees

UNIT-II

Graphs – Walk- path - cycle – Bipartite graphs

UNIT-III

Trees – Cut Edges and Bonds – Cut vertices- Cayley's formula

UNIT-IV

Connectivity – Blocks – Euler tours – Hamiltonian cycles -Closure of a graph – Chavatal theorem for Non-Hamiltonian simple graphs.

UNIT-V

Matchings- Matchings and coverings in a Bipartite Graphs-Perfect Matchings

UNIT-VI

Independent sets – Cliques – Ramsey's numbers

UNIT-VII

Edge colourings- Edge chromatic Number – Vizing's Theorem

UNIT-VIII

Vertex colouring – Brook's theorem – Hajo's conjecture – Chromatic polynomials.

UNIT-IX

Planar graphs – Plane and Planar graphs - Dual graphs – Euler's formula

UNIT-X

Bridges – Kuratowski's Theorem – The Time table Problem

UNIT-XI

The five colour theorem – Non-Hamiltonian planar graphs

UNIT-XII

Directed graphs – Directed Path – Directed Cycles

UNIT-XIII

Networks - Flows – Cuts - Problems

UNIT-XIV

Max-Flow Min-cut theorem and Applications

REFERENCES:

1. J.A.Bondy and U.S.R Murty, *Graph Theory with Applications* Macmillan, London.
2. A Text book of Graph Theory , Balakrishnan. R, Ranganathan .K, Second Edition, Springer.
3. Invitation to Graph Theory, S.Arumugam and S.Ramachandran, Scitech Publications India

Learning Outcomes:

Upon completion of the course, students should possess the following skills:

- understand the basic concepts of graphs, directed graphs, and weighted graphs and able to present a graph by matrices.
- understand the properties of trees and able to find a minimal spanning tree for a given weighted graph.
- understand Eulerian and Hamiltonian graphs.

Course Code	Title of the Course
31142	FUNCTONAL ANALYSIS

Course Objectives

The objective of the course is to:

- the study of spaces of functions.
- introduce the students to the basic concepts and theorems

Course Description:

UNIT-I

Normed space - Banach space – Properties of Normed spaces

UNIT-I

Convex sets- Quotient spaces-Equivalent norms

UNIT-III

Finite dimensional normed spaces and subspaces- Compactness and finite dimension

UNIT-IV

Linear operators – Bounded linear operators

UNIT-V

Linear functional – Normed spaces of operators..

UNIT-VI

Continuous or bounded linear operators- Dual spaces

UNIT-VII

Inner product spaces-Definition and examples-Orthonormal sets and bases

UNIT-VIII

Annihilators-Projections

UNIT-IX

Hilbert space- Linear functionals on Hilbert spaces

UNIT-X

Reflexivity of Hilbert spaces

UNIT-XI

Riesz's theorem – Hilbert adjoint operator – Self-adjoint, unitary and normal operators.

UNIT-XII

Hahn – Banach theorem - Adjoint operator – Category theorem – Uniform boundedness theorem.

UNIT-XIII

Strong and weak convergence – Convergence of sequences of operators and functionals

UNIT-XIV

Open mapping theorem -Closed graph theorem

REFERENCES:

1. E. Kreyszig, *Introduction to Functional Analysis with Applications*, (John Wiley and Sons, 2006).
2. G. Bachman and L. Narici, *Functional Analysis*, (Academic Press, 1966)
3. F. Riesz and B. Sz. Nagay, *Functional Analysis*, (Dover Publications, Inc., 1965).

Learning Outcomes:

By the end of this course, students should be able to:

- describe the properties of normed linear spaces and construct examples of such spaces.
- extend basic notions from calculus to metric spaces and normed vector spaces.
- state and prove theorems about finite dimensionality in normed vector spaces.
- state and prove the Cauchy-Swartz inequality and apply it to the derivation of other inequalities.
- prove that a given space is a Hilbert spaces or a Banach Spaces.
- describe the dual of a normed linear space.

Course Code	Title of the Course
31143	NUMERICAL ANALYSIS

Course Objectives:

The general objective of the course is to:

- Derive appropriate numerical methods to solve algebraic and transcendental equations.
- develop appropriate numerical methods to approximate a function.
- develop appropriate numerical methods to solve a differential equation.
- derive appropriate numerical methods to evaluate a derivative at a value.
- derive appropriate numerical methods to solve a linear system of equations.
- perform an error analysis for various numerical methods.
- derive appropriate numerical methods to calculate a definite integral.
- code various numerical methods in a modern computer language.

Course Description:

UNIT-I

Transcendental and polynomial equations : Rate of convergence of iterative methods

UNIT-II

Methods for finding complex roots – Polynomial equations

UNIT-III

Birge – Vieta method, Bairstow's method, Graeffe's root squaring method.

UNIT-IV

System of Linear Algebraic equations and Eigen Value Problems : Error Analysis of direct and iteration methods

UNIT-V

Finding Eigen values and Eigen vectors – Jacobi and Power methods.

UNIT-VI

Interpolation and Approximation : Hermite Interpolations – Piecewise and Spline Interpolation - Bivariate Interpolation

UNIT-VII

Approximation – Least square approximation and best approximations.

UNIT-VIII

Differentiation and Integration : Numerical Differentiation – Optimum choice of Step – length – Extrapolation methods

UNIT-IX

Partial Differentiation – Methods based on undetermined coefficient – Gauss methods.

UNIT-X

Ordinary differential equations : Local truncation error – Problems

UNIT-XI

Euler, Backward Euler, Midpoint, -Problems

UNIT-XII

Taylor's Method –Related Problems

UNIT-XIII

Second order Runge Kutta method - Stability analysis.

REFERENCES:

1. M.K.Jain, S.R.K.Iyengar and R.K.Jain, Numerical Methods for Scientific and Engineering Computation, III Edn. Wiley Eastern Ltd., 1993.
2. Kendall E.Atkinson, An Introduction to Numerical Analysis, II Edn., John Wiley & Sons, 1983.
3. M.K.Jain, Numerical Solution of Differential Equations, II Edn., New Age International Pvt Ltd., 1983.
4. Samuel, D. Conte, Carl. De Boor, Elementary Numerical Analysis, McGraw Hill International Edn., 1983.

Learning Outcomes:

The students will become proficient in:

- understanding the theoretical and practical aspects of the use of numerical methods.
- implementing numerical methods for a variety of multidisciplinary applications.
- establishing the limitations, advantages, and disadvantages of numerical methods.
- demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions.
- derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.

Course Code	Title of the Course
31144	**PROBABILITY AND STATISTICS**

Course Objectives

The objective of the course is to:

- study the key concepts of probability, including discrete and continuous random variables, probability distributions, conditioning, independence, expectations, and moments.
- apply the basic rules and theorems in probability including Bayes's theorem and the Central Limit Theorem (CLT).
- apply the concepts of interval estimation and confidence intervals.
- apply the concepts of hypothesis testing t and F distributions.

Course Description:

UNIT-I

Probability and Distribution: Introduction – Set theory – The probability set function – Conditional probability and independence

UNIT-II

Random variables of the discrete type – Random variables of the continuous type –

UNIT-III

Properties of the distribution function – expectation of random variable – some special expectations – Chebyshev's Inequality.

UNIT- IV

Multivariate Distributions: Distributions of two random variables – Conditional Distributions and Expectations

UNIT-V

The correlation coefficient – Independent random variables – extension to several Random variables.

UNIT-VI

Some special Distributions: The Binomial and Related Distributions – The Poisson Distribution

UNIT-VII

The Gamma and Chi-square Distributions – The Normal Distribution – The Bivariate Normal Distribution.

UNIT-VIII

Distributions of functions of Random variables: Sampling Theory – Transformations of variables of the discrete type

UNIT-IX

Transformations of variables of the continuous type – the Beta, t and F distributions – Extensions of the change – of – variable Technique

UNIT-X

Distributions of order statistics – The Moment generating – Function, Techniques

UNIT-XI

The distributions of X and ns^2/σ^2 – Expectations of functions of Random variables

UNIT-XII

Limiting Distributions: Convergence in distribution – convergence in probability

UNIT-XIII

Limiting Moment Generating Functions – The Central Limit Theorem

UNIT-XIV

Some theorems on Limiting Distributions.

REFERENCES:

1. Introduction to Mathematical Statistics, (Fifth edition) by Robert V.Hogg and AllenT. Craig Pearson Education Asia.
2. M.Fisz, Probability, Theory and Mathematical Statistics, John Wiley and Sons, New York. 1963.
3. V.K.Rohatgi, An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern Ltd., New Delhi, 1988 (3rd Print).

Learning Outcomes:

Students who successfully complete this course should be able to demonstrate understanding of:

- basic probability axioms, rules and the moments of discrete and continuous random variables as well as be familiar with common named discrete and continuous random variables.
- how to derive the probability density function of transformations of random variables and use these techniques to generate data from various distributions.

- how to calculate probabilities, and derive the marginal and conditional distributions of bivariate random variables.
- discrete time Markov chains and methods of finding the equilibrium probability distributions.

4.4: PROJECT WORK / DISSERTATION

PROJECT WORK

- After the Completion of First Year, students are eligible to commence the Project work under the supervision of the qualified guide. The Candidates are permitted to submit the Project work on completing 18 months of the course but not later than five years after the commence of the course
- The Guide / Supervisor of the Project work shall be an approved guide of Alagappa University, Karaikudi or a person with an M.Phil Degree working with three years teaching experience in any Government or Government Aided College in Department of Mathematics with Ph.D. (Mathematics) qualification.
- The students shall submit the consent letter from the guide in the prescribed format before the commencement of the project work.
- The Project Report shall not exceed 150 Pages and be not less than 50 Pages
- The Project Report should be certified by the Approved Guide with Self Declaration of the Candidate for assuring the Quality and Originality of the work.
- There is an internal Viva-Voce examination for the Project Report submitted.

- **The Split up of marks for the project will be :**

1. Innovativeness	-	25 Marks
2. Methodology and Analysis	-	25 Marks
3. Reporting and Presentation	-	25 Marks
4. Viva – Voce examination	-	25 Marks
TOTAL :	-	**100 Marks**

Appendix II

(Model for wrapper and inside title page of Synopsis / thesis of the M.Sc work)

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Title of the Thesis

THESIS SUBMITTED TO ALAGAPPA UNIVERSITY IN PARTIAL FULFILMENT FOR THE AWARD OF THE DEGREE OF

MASTER OF SCIENCE

IN

MATHEMATICS

By

____

(Name of the candidate)

(Register Number of the Candidate:______)

Under the supervision of

____

(Name of the Research Supervisor)

____

DIRECTORATE OF DISTANCE EDUCATION

ALAGAPPA UNIVERSITY

[Accredited with A+ Grade by NAAC (CGPA: 3.64) in the Third Cycle]

KARAIKUDI – 630 003

INDIA

____

Month and Year

[Note: The items in Italics as such are not to be scripted, but only the appropriate details pertaining to them need to be in the space provided]

e. 3. Duration of the Programme:

The programme for the Postgraduate degree in Mathematics shall consist of two academic years divided in to four semesters. Each semester consists of four theory Papers. Each theory course carries 4 credits and each semester consist of 16 credits.

e. 4. Faculty and Support Staff Requirements:

The programme for the Undergraduate degree in Mathematics requires the following faculty and supporting staff:

Staff Category	Required
Core Faculty*	3
Faculty – Specialization*	2
Clerical Assistant	1

* Faculty may belongs to at least Assistant Professor Level

e. 5. Instructional Delivery Mechanisms:

The instructional delivery mechanisms of the programme includes SLM – study materials, face to face contact session for theory course of the programme, e-content of the study materials in the form of CD, MOOC courses wherever applicable.

e. 6. Identification of Media:

The SLM – designed study materials will be provided in print media as well is in the form of CD which carries electronic version of the study material in addition to MOOC courses.

e. 7. Student Support Services:

The student support services will be facilitated by the head quarter i.e., Directorate of Distance Education, Alagappa University, Karaikudi and its approved Learning Centres located at various parts of Tamil Nadu. The pre-admission student support services like counselling about the programme including curriculum design, mode of delivery, fee structure and evaluation methods will be explained by the staff at head quarter and Learning Centres. The post-admission student support services like issuance of identity card, study materials, etc. will be routed through the Learning Centres. The face to face contact sessions of the programme for both theory and practical courses will be held at the head quarter and Learning Centres. The conduct of end semester examinations, evaluation and issuance of certificates will be done by office of the controller of examinations, Alagappa University, Karaikudi.

f. Procedure for Admission, curriculum transaction and evaluation:

f. 1. Admission Eligibility:

A candidate who has passed B.Sc. (Mathematics / Applied Mathematics) of any University accepted by the Syndicate as equivalent there to shall be eligible to appear and qualify for the M.Sc Degree in Mathematics of this University after a course of study of three academic years.

f. 2. Curriculum Transactions:

The classroom teaching would be through chalk and talk method, use of OHP, Power Point presentations, web-based lessons, animated videos, etc. The face to face contact sessions would be such that the student should participate actively in the discussion. Student seminars would be conducted and scientific discussions would be arranged to improve their communicative skill.

The face to face contact sessions will be conducted in following durations;

Course Type	**Face to Face Contact Session per Semester (in Hours)**
Theory Courses (4 courses with 4 credits each)	64
Total	**64**

f. 3. Evaluation:

The examinations shall be conducted separately for theory and practical's to assess the knowledge acquired during the study. There shall be two systems of examinations viz., internal and external examinations. In the case of theory courses, the internal evaluation shall be conducted as Continuous Internal Assessment via. Student assignments preparation and seminar, etc. The internal assessment shall comprise of maximum 25 marks for each course. The end semester examination shall be of three hours duration to each course at the end of each semester. In the case of Practical courses, the internal will be done through continuous assessment of skill in demonstrating the experiments and record or report preparation. The external evaluation consists of an end semester practical examinations which comprise of 75 marks for each course.

f. 3.1. Question Paper Pattern:

Answer all questions (one question from each unit with internal choices Time: 3 Hours Max. Marks: 75
Part A- 10 x 2 Marks = 20 Marks
Part B -5 x 5 Marks = 25 Marks
Part C- 3 x 10 Marks = 30 Marks

f. 3.2. Distribution of Marks in Continuous Internal Assessments:

The following procedure shall be followed for awarding internal marks for **theory** courses

Component	Marks
Assignments (5 questions per course)	25
Total	**25**

f. 3.3. Passing Minimum:

- For internal Examination, the passing minimum shall be 40% (Forty Percentage) of the maximum marks (25) prescribed for UG and PG Courses.
- For External Examination, the passing minimum shall be 40% (Forty Percentage) of the maximum marks (75) prescribed for UG and PG Courses.
- In the aggregate (External + Internal), the passing minimum shall be 40% for UG and 50% for PG courses.

f. 3.4. Marks and Grades:

The following table gives the marks, grade points, letter, grades and classification to indicate the performance of the candidate.

Range of Marks	Grade Points	Letter Grade	Description
90-100	9.0-10.0	O	Outstanding
80-89	8.0-8.9	D+	Excellent
75-79	7.5-7.9	D	Distinction
70-74	7.0-7.4	A+	Very Good
60-69	6.0-6.9	A	Good
50-59	5.0-5.9	B	Average
00-49	0.0	U	Re-appear
ABSENT	0.0	AAA	ABSENT

C_i = Credits earned for the course i in any semester
G_i = Grade Point obtained for course i in any semester.
n refers to the semester in which such courses were credited

For a semester;

Grade Point Average [GPA] = $\sum_i C_i G_i / \sum_i C_i$

Grade Point Average = <u>Sum of the multiplication of grade points by the credits of the courses</u>

Sum of the credits of the courses in a semester

For the entire programme;

Cumulative Grade Point Average [CGPA] = $\sum_n \sum_i C_{ni} G_{ni} / \sum_n \sum_i C_{ni}$

CGPA = <u>Sum of the multiplication of grade points by the credits of the entire programme</u>

Sum of the credits of the courses for the entire programme

CGPA	Grad	Classification of Final Result
9.5-10.0 9.0 and above but below 9.5	O+ O	First Class- Exemplary*
8.5 and above but below 9.0 8.0 and above but below 8.5 7.5 and above but below 8.0	D++ D+ D	First Class with Distinction*
7.0 and above but below 7.5 6.5 and above but below 7.0 6.0 and above but below 6.5	A++ A+ A	First Class
5.5 and above but below 6.0 5.0 and above but below 5.5	B+ B	Second Class
0.0 and above but below 5.0	U	Re-appear

*The candidates who have passed in the first appearance and within the prescribed semester of the PG Programme are eligible.

f. 3.5. Maximum duration for the completion of the course:

The maximum duration for completion of M.Sc., Degree in Mathematics programme shall not exceed ten semesters from their sixth semester.

f. 3.6. Commencement of this Regulation:

These regulations shall take effect from the academic year 2018-2019 (June session) i.e., for students who are to be admitted to the first year of the course during the academic year 2018-2019 (June session) and thereafter.

f. 4. Fee Structure:

The programme has the following Fee Structure:

Sl. No.	Fees Detail	Amount in Rs.	
		First Year	Second Year
1	Admission Processing Fees	**300.00**	**-**
2	Tuition Fees	**4400.00**	**4400.00**
4	ICT Fees	**150.00**	**150.00**
	TOTAL	**4850.00**	**4550.00**

The above mentioned fee structure is exclusive of Exam fees.

***g.* Requirement of the laboratory support and Library Resources:**

The students who have enrolled themselves in M.Sc., Mathematics Programme shall attend the face to face contact session for Theory Courses at their respective Learning Centres.

Directorate of Distance Education, Alagappa University, Karaikudi housing an excellent Library facility with adequate number of copies of books in relevant titles for M. Sc., Mathematics programme. The Central Library of Alagappa University also having good source of reference books. The books available at both the libraries are only for reference purpose and not for lending services.

***h.* Cost estimate of the programme and the provisions:**

The cost estimate of the programme and provisions for the fund to meet out the expenditure to be incurred in connection with M. Sc., Mathematics programme. as follows:

S.No.	**Expenditure Heads**	**Approx. Amount in Rs.**
1	Programme Development	10,00,000/-
2	Programme Delivery	20,00,000/-
3	Programme Maintenance	3,00,000/-

***i.* Quality assurance mechanism and expected programme outcomes:**

i. 1. University's Moto:

'Excel ence in Action'

i. 2. University's Vision Statement:

Achieving Excellence in all spheres of Education, with particular emphasis on "PEARL"- Pedagogy, Extension, Administration, Research and Learning.

i. 2. University's Objectives:

1. Providing for Instructions and Training in such Branches of Learning as the University may determine.
2. Fostering Research for the Advancement and Dissemination of Knowledge

i. 3. University's Quality Policy:

Attaining Benchmark Quality in every domain of 'PEARL' to assure Stakeholder Delight through Professionalism exhibited in terms of strong purpose, sincere efforts, steadfast direction and skillful execution.

i. 4. University's Quality Quote:

Quality Unleashes Opportunities towards Excellence (QUOTE)

i.5. Programme's Review Mechanism:

The quality of the programme depends on scientific construction of the curriculum, strong-enough syllabi, sincere efforts leading to skillful execution of the course of the study. The ultimate achievement of M.Sc., Mathematics programme of study may reflect the gaining of knowledge and skill in the subject. And all these gaining of knowledge may help the students to get new job opportunities, upgrading in their position not only in employment but also in the society, make students feel thirsty to achieve in research in the fields associated with the discipline- Mathematics achieving in competitive examinations on the subject.

The benchmark qualities of the programme may be reviewed based on the performance of students in their end semester examinations. Apart from the end semester examination-based review feedback from the alumni, students, parents and employers will be received and analyzed for the further improvement of the quality of the M.Sc., Mathematics Programme.

MINUTES OF THE MEETING OF THE BOARD OF STUDIES IN MATHEMATICS (DDE) HELD ON 17.06.2017 AT 2.00 p. m. IN THE DEPARTMENT OF MATHEMATICS, ALAGAPPA UNIVERSITY, KARAIKUDI.

Members Present

1. Dr. N. Anbazhagan - Chairman
2. Dr. M. Marudai - Member
3. Dr. R. Uthayakumar - Member
4. Dr. R. Asokan - Member
5. Dr. M. Mullai - Member
6. Dr. J. Vimala - Member

The chairman of the Board Dr. N. Anbazhagan welcomed the members.

1. Board of Studies in Mathematics has thoroughly discussed the B. Sc., (Mathematics), M. Sc., (Mathematics) syllabi and made necessary changes and corrections in the existing syllabi of all the above said programmes.

2. The corrected syllabi is enclosed herewith.

Dr. N. Anbazhagan   Dr. M. Marudai   Dr. R. Uthayakumar

Dr. R. Asokan   Dr. M. Mullai   Dr. J. Vimala

(PTO)